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TECHNICAL report

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Air Conditioner Requirements Validation Review of Mobile Subscriber Equipment (MSE)

by
Gregory F. Brainard

Report Date
May 1992

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Belvoir RD&E Center
U.S. ARMY TRADOC

United States Army
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Fort Belvoir, Virginia 22060-5606

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This report assesses the tactical electric and cooling requirements of the Mobile Subscriber Equipment (MSE) system for the "Air Conditioner Requirements Review Program."

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Environmental Control Unit (ECU)
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US Army Belvoir RD&E Center
Fort Belvoir, Virginia 22060-5606

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Section I

Background

The U.S. Army's Troop Support Command (TROSCOM) and the Training and Doctrine Command (TRADOC) initiated the "Air Conditioner Requirements Review Program" to establish requirements for a new generation of environmental control equipment. TRADOC's Ordnance School; TROSCOM's Special Programs Management Office; and Belvoir Research, Development, and Engineering Center (BRDEC), Systems Assessment Team were the program's primary participants. The Systems Assessment Team was directed to assess the electric power and cooling requirements of selected Army systems. To assist in this effort, a Special Sample Data Collection (SSDC) Project was established under the auspices of the TROSCOM Sample Data Collection Program. The SSDC Project inventories each system, paves the way for the assessment, and conducts operator interviews regarding the effectiveness of existing electric power and cooling equipment. Systems to be assessed include: DAS-3, MSE, TACMIS, FAADS, SICPS, and Patriot.

Section II

Approach

It is necessary to account for electrical power demand when determining the cooling load of a system. This process involves three steps:

First, all power consuming equipment in the system's shelter must be inventoried. This includes collecting the manufacturer's nameplate data and inspecting manuals for each item.

Second, the system's power consumption must be measured while equipment items, groups, and the entire system are powered-up and powered-down. From this data, the power demand of each piece of equipment and a predicted maximum system power demand can be derived. This technique includes power conditioner losses with the supported equipment's power demand.

Finally, the shelter's thermal characteristics and personnel and tactical requirements must be entered into the Shelter Systems Assessment Model (SAM). The computer model can then determine cooling loads and Environmental Control Unit (ECU) suitability under hypothetical ambient conditions. When test conditions allow, the ECU needs should be validated using temperature data taken during the test and by interviewing experienced system operators.

Section III

System Description

The mission of the Mobile Subscriber Equipment (MSE) system is to:

- Provide secure, mobile radiotelephone communications to subscribers.
- Provide command posts with secure communications.
- Transmit operations orders and overlays.

The MSE system is housed in both the S-250 and the longer S-250E Shelters. The subsystem shelters treated in this report are listed in Table 1, including nomenclature, system codes, and abbreviations for each.

Table 1. MSE Subsystem Shelters Reviewed

NOMENCLATURE	SYSTEM CODE	ABBREV.	SHELTER
Large Extension Node Switch, AN/TTC-46			
Switching Group	ON-305/TTC-46	LES-S	S-250
Operations Group	OL-412/TTC-46	LES-O	S-250E
Node Center Switch, AN/TTC-47			
Switching Group	ON-306/TTC-47	NCS-S	S-250
Operations Group	OL-413/TTC-47	NCS-O	S-250E
Single Shelter Subsystems			
Small Extension Node Switch	AN/TTC-48(V)1	SES	S-250E
Management Facility	AN/TSQ-154	MF	S-250
Multichannel Radio Terminal (Line-of-Sight Radio)	AN/TRC 190(V)4	LOS	S-250
Radio Access Unit	AN/TRC-191	RAU	S-250
Maintenance Facility	AN/TSM-182*	MTC-F	S-250E

Note:

* The maintenance system (AN/TSM-182) is sometimes assigned two shelters. One serves as the operations shelter and the other as a spare parts storage shelter. The system tested for this report had only the primary shelter.

Further information on each subsystem including prime mover, generator, personnel, equipment, and ECU can be found on pages 4 through 9 of the Appendix. Generator, ECU, and personnel information are summarized in Table 2 of this report.

Table 2. Generators, ECUs, and Personnel

SYSTEM	CURRENT GENERATOR	CURRENT ECU	# PERSONNEL
MSE			
AN/TTC-46			
ON-305	10 kW, 60 Hz, 1 Phase	1.5 kW Heater, 2 Blowers	0
OL-412	10 kW, 60 Hz, 1 Phase	9 KBTUH A/C, 1 Blower	2
AN/TCC-47			
ON-306	10 kW, 60 Hz, 1 Phase	1.5 kW Heater, 2 Blowers	0
OL-413	10 kW, 60 Hz, 1 Phase	9 KBTUH A/C, 1 Blower	2
AN/TCC-48	10 kW, 60 Hz, 1 Phase	9 KBTUH A/C, 1 Blower	2
AN/TRC-190	5 kW, 60 Hz, 1 Phase	1.5 kW Heater, 2 Blowers	2*
AN/TRC-191	5 kW, 60 Hz, 1 Phase	1.5 kW Heater, 2 Blowers	2*
AN/TSQ-154	10 kW, 60 Hz, 1 Phase	9 KBTUH AC	2
AN/TSM-182			
Primary	10 kW, 60 Hz, 1 Phase	9 KBTUH A/C	2
Storage	10 kW, 60 Hz, 1 Phase	Not Available	2

Note:

* The AN/TRC-190 and AN/TRC-191 shelters were originally designed to be unmanned. The system observed by the testing team had two operators assigned to each.

Section IV

Discussion

An inventory of MSE was performed for each shelter. Each piece of power consuming equipment was listed as a column heading on a Power Measurement Load Configuration form (see page 13 of Appendix). This form documents the switch position for each equipment item at each step of the test sequence. The test began with all the equipment except the heater on or in standby mode. The test team took power consumption readings at the power source while operators switched off equipment in sequence. The power readings were entered in the Power Generator Performance form (see page 14 of Appendix). This form records the load on the generator for each step in the test sequence.

The power consumed by each item, including power conditioning losses (see Tables 3 through 11), is derived from the change in total power as the item is switched off. The power consumption data for each shelter listed on Tables 3 through 11 is grouped into three subcategories.

The first category, "Total Internal Power Demand Measured in Operational Mode," refers to equipment that was tested at its full operational capacity. The second category, "Total Internal Power Dissipation," includes equipment for which test conditions prevented maximum load operation. For example, a transmitter may not be operable unless other system sections are geographically situated in a specific manner. The internal power dissipation is the electric power which the ECU capacity must compensate for to maintain the desired internal temperature. The final total, "Total Generator Load for Shelter," includes the electric load which does not contribute to the cooling requirement.

Power consuming items and their respective power demand were used as input for several computer runs of the SAM (see Figures 1 through 3). An internal temperature of 90°F was selected for Human Engineering MIL-STD-1472 considerations. Internal humidity was limited to 60%. Desert conditions (environment 1, AR 70-38) and equipment power use of 0 through 5 kW were analyzed. Assumptions used in the computer analysis are found in Table 12.

Table 3. MSE Equipment Power Draws Switching Group ON-305/TTC-46

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Fixture, Light Fluorescent	(2)	15 watt	42
Light, Incandescent		30 watt	30
Supply, Power	(3)	PP-7815	1700
Supply, Power	(2)	PP-7711	200
Total Internal Power Demand Measured in Operational Mode			***2.09 kW***
Group, Time Division Switching		Right Hand**	100 *
Group, Time Division Switching		Left Hand**	
Set, Intercom		LS-147C/FI	15 *
TSEC	(2)	KGX-93	200 *
Oscillator, Frequency		O-1838	3 *
TSEC	(3)	KG-94A	247 *
Total Internal Power Dissipation			***2.66 kW***
Heater, 1500 watt		P-15	1600
Blower, Ventilation	(2)	—	300
Total Generator Load for Shelter			***4.56 kW***

*Operated in stand-by mode

**Equipment is powered through a common switch and was turned on and off simultaneously. Therefore, only total power consumption could be calculated).

Table 4. MSE Equipment Power Demand Operations Group OL-412/TTC-46

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Terminal, Video Display		SM-D-820662	35
DC Converter		CV-3743/T	38
Fixture, Light Fluorescent	(3)	15 watt	53
Total Internal Power Demand Measured in Operational Mode			***.26 kW***
Transport, Tape	(2)	AN/UYH-5	30 *
Terminal, Communications		AN/UGC-74B(V)3	90 *
Unit, Order Wire Control		C-11878/T	35 *
Set Intercom		LS147C/FI	15 *
Panel, Call Service Position		SM-D-817230	40 *
Receiver Transmitter	(2)	AN/GRC-224	30 *
Group, Central Processor		OL-386	135 *
Bay, Routing		—	515 *
Total Internal Power Dissipation			***1.15 kW***
Environmental Control Unit (H9KH-115P)		Heating Mode Cooling Mode	2450 3000
Blower, Ventilation		—	150
Total Generator Load for Shelter			***4.30 kW***

* Operated in stand-by mode

Table 5. MSE Equipment Power Demand Switching Group ON-306/TTC-47

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Fixture, Light Fluorescent	(2)	15 watt	42
Light, Incandescent		30 watt	30
Supply, Power	(3)	PP-7815	1700
Supply, Power	(2)	PP-7711	200
Oscillator		O-1838	3
Total Internal Power Demand Measured in Operational Mode			***2.10 kW***
Set, Intercom		LS-147C/FI	15 *
TSEC	(15)	KG-94A	300 *
TSEC	(2)	KGX-93	200 *
Total Internal Power Dissipation			***2.61 kW***
Heater, 1500 watt		P-15	1600
Blower, Ventilation	(2)	—	300
Total Generator Load for Shelter			***4.51 kW***

* Operated in stand-by mode

Table 6. MSE Equipment Power Demand Operations Group OL-413/TTC-47

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
DC Converter		CV-3734/T	38
Fixture, Light Fluorescent	(3)	15 watt	63
Terminal, Video Display		SM-D-820662	35
Light, Incandescent	(3)	30 watt	60
Total Internal Power Demand Measured in Operational Mode			***.32 kW***
Transport, Tape	(2)	AN/UYH-5	30 *
Terminal, Communications		AN/UGC-74B(V)3	90 *
Unit, Order Wire Control		C-11878/T	35 *
Set, Intercom		LS147C/FI	15 *
Panel, Call Service Position		SM-D-817230	40 *
Receiver Transmitter	(2)	AN/GRC-224	30 *
Group, Central Processor		OL-386	400 *
Bay, Routing		—	415 *
TSEC		KY-57	0 *
Total Internal Power Dissipation			***1.37 kW***
Environmental Control Unit (H9KH-115P)		Heating Mode Cooling Mode	2450 3000
Blower, Ventilation		—	150
Total Generator Load for Shelter			***4.52 kW***

* Operated in stand-by mode

Table 7. MSE Equipment Power Demand Small Extension Node AN/TTC-48(V)

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Fixture, Light Fluorescent	(3)	15 watt	63
Light, Incandescent	(3)	30 watt	60
Supply, Power, Group Modem		MD-1231(P)/T	40
Total internal Power Demand Measured in Operational Mode			***.28 kW***
Module, Logic Group		TD-1426(P)T	100 *
TSEC		KG-94A	20 *
Unit, Order Wire Control		C-11878/T	35 *
TSEC		KY-57	65 *
Switchboard, Telephone	(2)	SB-4303(P)/G	160 *
Total Internal Power Dissipation			***.66 kW***
Environmental Control Unit (H9KH-115P)		Heating Mode Cooling Mode	2450 3000
Blower, Ventilation		—	150
Total Generator Load for Shelter			***3.81 kW***

* Operated in stand-by mode

Table 8. MSE Equipment Power Demand Multichannel Radio Terminal AN/TRC-190(V)

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Fixture, Light Fluorescent	(3)	15 watt	63
Light, Incandescent		30 watt	30
Total Internal Power Demand Measured in Operational Mode			***.21 kW***
Supply, Power, Group Modem		MD-1231(P)/T	40 *
Unit, Order Wire Control		C-11878/T	35 *
Receiver, Transmitter		AN/GRC-226(V)1	46 *
Receiver, Transmitter		AN/GRC-226(V)2	76 *
Receiver, Transmitter	(2)	AN/GRC-224	30 *
TSEC		KY-57	0 *
Total Internal Power Dissipation			***.44 kW***
Heater, 1500 watt		P-15	1600
Blower, Ventilation	(2)	—	300
Total Generator Load for Shelter			***2.34 kW***

* Operated in stand-by mode

Table 9. MSE Equipment Power Demand Radio Access Unit AN/TRC-191

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Fixture, Light, Fluorescent	(3)	15 watt	42
Light, Incandescent		30 watt	30
Module, Logic Group		TD-1426(P)T	20
Supply, Power, Group Modem		MD-1231(P)T	40
Total Internal Power Demand Measured in Operational Mode			***.25 kW***
Receiver Transmitter	(8)	RT-1539	270 *
Multicoupler, Antenna Controller, Receiver, Transmitter Control, Radio Access Unit		CV-2391** C-11865** K022**	287 *
Unit, Control, Order Wire		C-11878/T	35 *
TSEC		KG-94A	20 *
TSEC		KY-57	0 *
Total Internal Power Dissipation			***.86 kW***
Heater, 1500 watt		P-15	1600
Blower, Ventilation	(2)	—	300
Total Generator Load for Shelter			***2.76 kW***

*Operated in stand-by mode

**Equipment is powered through a common switch and was turned on and off simultaneously. Therefore, only total power consumption could be calculated.

Table 10. MSE Equipment Power Demand Management Facility AN/TSQ-154

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Charger, Battery		PP-8190/G	80
Fixture, Light, Fluorescent	(3)	15 watt	63
Computer, Zenith		2 FL-171-42	15
Light, Incandescent	(3)	30 watt	60
Total Internal Power Demand Measured in Operational Mode			***.36 kW***
Terminal, Communications		AN/UGC-74B(V)3	90 *
Facsimile		AN/UXC-7	15 *
Intercom		LS147C/FI	15 *
Printer		ASP 1000	10 *
Supply, Power		PP-6224/U	0 *
Total Internal Power Dissipation			***.49 kW***
Environmental Control Unit (H9KH-115P)		Heating Mode Cooling Mode	2450 3000
Lighting, Fluorescent 40 watt	(2)	External	100
Total Generator Load For Shelter			***3.49 kW***

* Operated in stand-by mode

Table 11. MSE Equipment Power Demand Maintenance Facility AN/TSM-182

Nomenclature	(count)	Model Number	Power Demand (watts)
Power Distribution Panel		—	40
Fixture, Light, Fluorescent	(3)	15 watt	63
Charger, Battery		PP-8190/G	80
Light, Incandescent	(3)	30 watt	60
Oscilloscope		—	41
Supply, Power		6255A	49
Total Internal Power Demand Measured in Operational Mode			***.33 kW***
Generator, Signal		SG-1171/U	32 *
Controller, Test		—	84 *
Tape Control Unit		—	115 *
Generator, Signal		8642M	207 *
Device, Interconnect		009643-01	29 *
Counter, Frequency		1992	35 *
Meter, Microwatt		4200	22 *
Multimeter		8840A/AF	22 *
Total Internal Power Dissipation			***.88 kW***
Environmental Control Unit (H9KH-115P)		Heating Mode Cooling Mode	2450 3000
Total Generator Load for Shelter			***3.88 kW***

* Operated in stand-by mode

Table 12. SAM Model Data

SHELTER SYSTEM ASSESSMENT MODEL
HVAC, POWER, AND WEIGHT REQUIREMENTS

Run Parameters	Calculation Details	Totals
Run Config. Environ. 1 S-250E ENV1 Structure: S-250 Weight: 770.0 lbs Other Settings AC Util. Conv. In. No CBR Total CFM: 40.0 Min. Interior Temp. 50. (°F) Max. Interior Temp. 90. (°F)	BTU/Equip. : 0. (>0 for AC, /Shelter: 6163. <0 for Heat) /Sensible & latent heat due to ventilation and personnel: 1812. KW/ a) Heat: 0.00 b) AC: 3.00 c) Equip: 0.00 d) Max(Heat,AC): 3.00 e) Max(MaxHeat,MaxAC,MaxEqp): 3.60 Note: "e" accounts for the highest individual power consumer regardless of usage rate and includes the startup factor. Personnel Wt: 534 lbs AC Weight: Equip Wt: -0- lbs Generator Wt:	BTU/hr Adjusted Power (KW) [Max(c+d,e)] 3.60 Total Wt. Incl. Struc. (LBS)

CONFIGURATION DESCRIPTIONS

CONFIGURATION: S-250E

Config description: S-250, 2 operators
It is housed in a: S-250 E

PERSONNEL LOADING

QTY	SENSIBLE LOAD (BTU/hr)	LATENT LOAD (BTU/hr)	VENTILATION (CFM/hr)	WEIGHT/PERSON (lb)
2	315.00	325.00	20	267

ENVIRONMENT CHARACTERISTICS

ENVIRONMENT NAME	TEMPERATURE OUTSIDE (°F)	HUMIDITY OUTSIDE (%)	WIND SPEED (mph)	SOLAR LOAD (BTU/HR/ft²)	GROUND TEMPERATURE (°F)
ENV1	120.0	3.0	8.9	231.0	145.0

DATA FOR STRUCTURES

NAME		TOP	SIDE	END	BOTTOM
S-250 E	Surface area (ft²):	40.63	69.29	66.64	40.63
	U-factor (BTU/hr/ft²/°F):	0.48	0.48	0.48	0.48
	Solar Absorb.(BTU/hr/ft²):	0.70	0.70	0.70	0.70
	Angle with horizontal:	0.00	90.00	90.00	180.00
	Area of Uninsulated Penetration by Conduits(ft²):	0.00	0.00	0.00	0.00

Weight (lbs): 770.0 Heat Capacitance (BTU/Lb/°F):

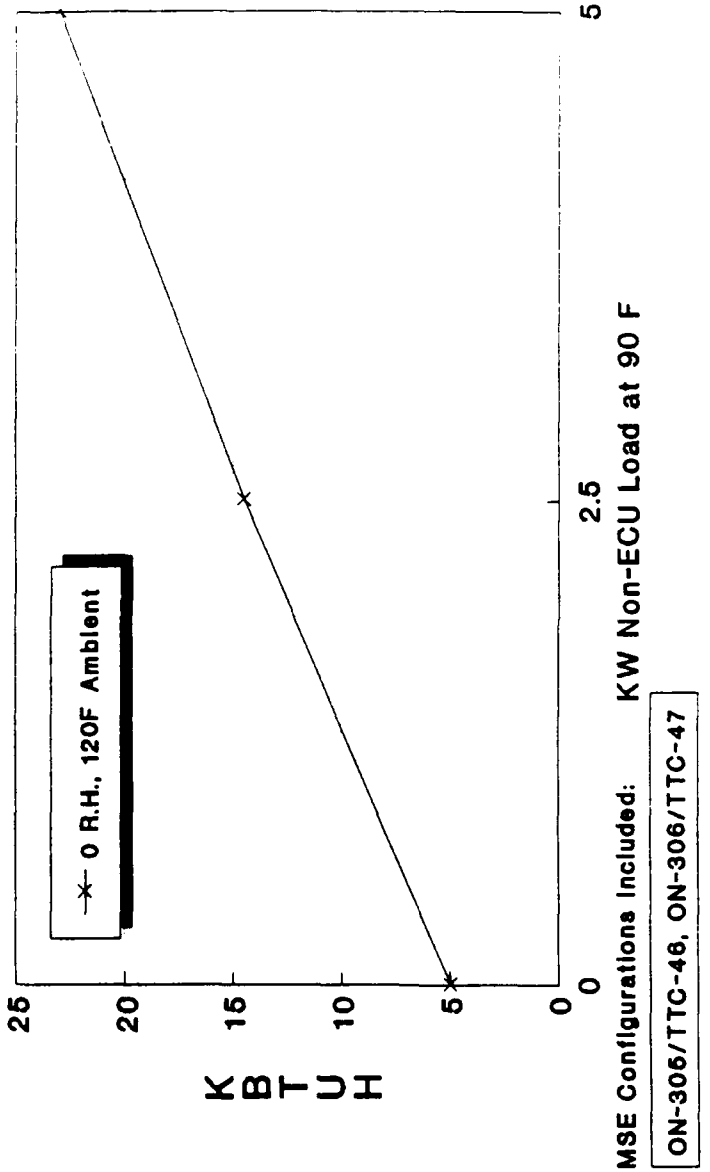

Figure 1. MSE Cooling Requirements, 90°F Internal, S-250 Shelter with No Operators

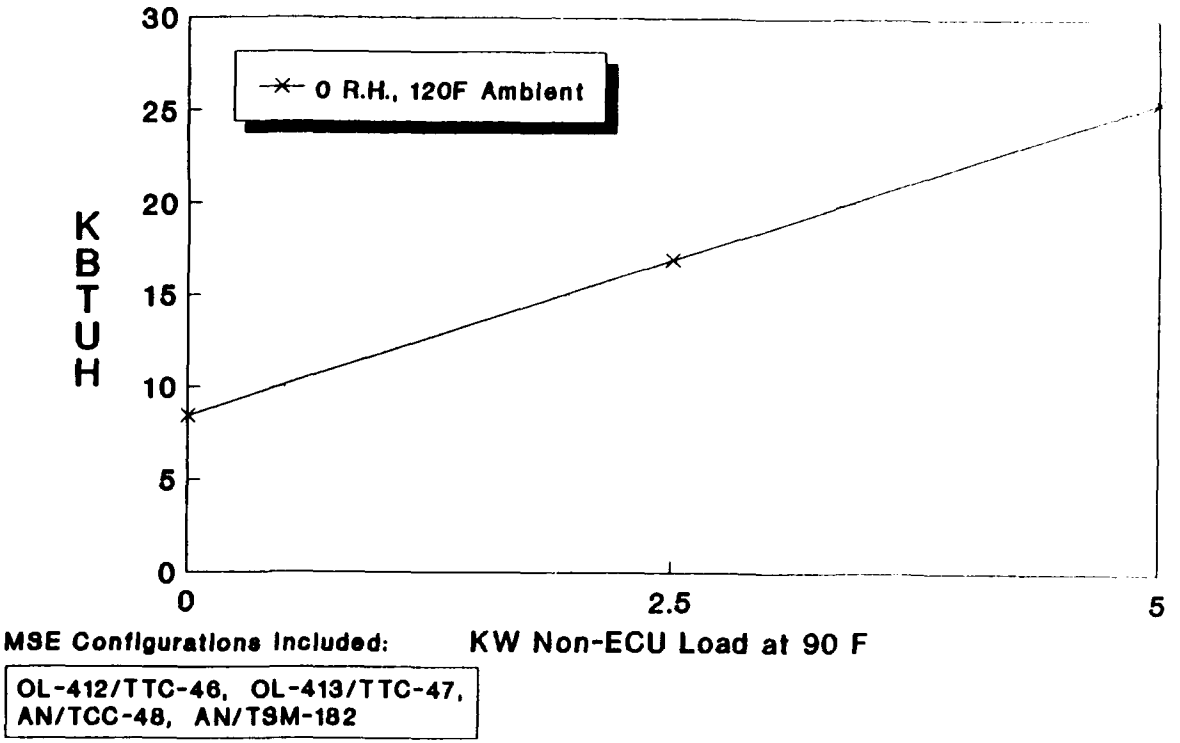

Figure 2. MSE Cooling Requirements, 90°F Internal, S-250E Shelter with Two Operators

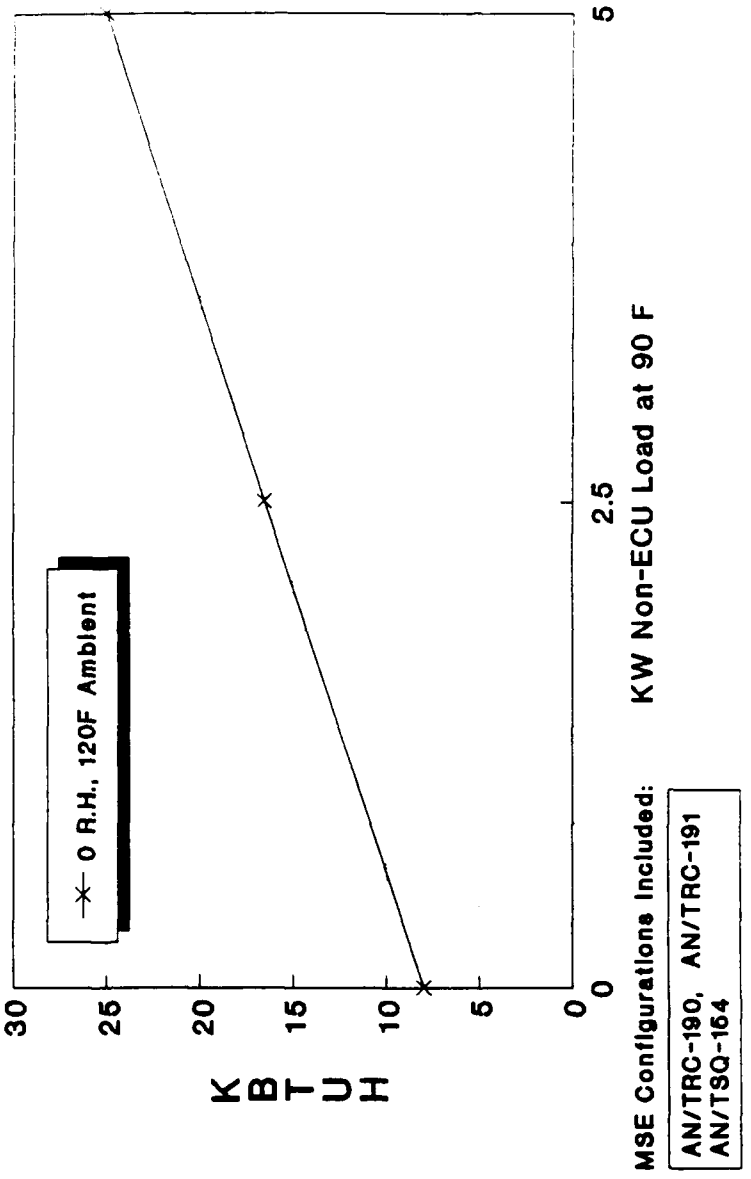

Figure 3. MSE Cooling Requirements, 90°F Internal, S-250 Shelter with Two Operators

Section V
Findings

Table 13 contains power demand and cooling load for each MSE shelter. Figures 1 through 3 provide curves which show the relationship between cooling and non-ECU electric load for three shelter configurations: S-250 shelters with no operators, S-250E shelters with two operators and S-250 shelters with two operators.

In all cases, the generator assignments are appropriate. Generator load configurations are summarized pictorially in Figure 4.

A comparison of the shelters' air conditioners (column 3, Table 2) and the shelters' cooling loads (column 4, Table 13) reveal significant shortcomings in several shelters.

Internal temperatures in the currently undercooled shelters (ON-305, ON-306, TRC-190, and TRC-191) can be expected to greatly exceed 120°F in the desert environment. Excessive internal temperatures like these are likely to cause major equipment malfunctions and render the shelters uninhabitable.

The OL-412 and OL-413 are undercooled. Camouflage netting to reduce solar loading and reduce internal power dissipation during hot periods is advised. If this is not possible, these systems may require a larger ECU. The TCC-48, TSQ-164, and TSM-182 will have sufficient cooling if solar loading is reduced (i.e., by netting).

solar loading is reduced (i.e., by netting).

Table 13. Cooling Requirements, 90°F

SYSTEM	GENERATOR LOAD (kW) INTERNAL	ECU*	TOTAL	TEMPERATURE REQUIREMENTS (°F) MAX. INT.	EXTERNAL	COOLING LOAD (KBTUH)
MSE						
AN/TTC-46						
ON-305	2.66	1.9	4.56	90	120	15.02
OL-412	1.15	3.15	4.30	90	120	12.34
AN/TCC-47						
ON-306	2.61	1.9	4.51	90	120	14.86
OL-413	1.37	3.15	4.52	90	120	13.12
AN/TCC-48	.66	3.15	3.81	90	120	10.40
AN/TRC-190	.44	1.9	2.34	90	120	9.48
AN/TRC-191	.86	1.9	2.76	90	120	10.93
AN/TSQ-154	.49	3.0	3.59	90	120	10.10
AN/TSM-182						
Primary	.88	3.0	3.88	90	120	11.43
Storage		Not Available		90	120	Not Available

* ECU load based on: Heater = 1.6 kW
A/C = 3.0 kW
Blower = 150 watts

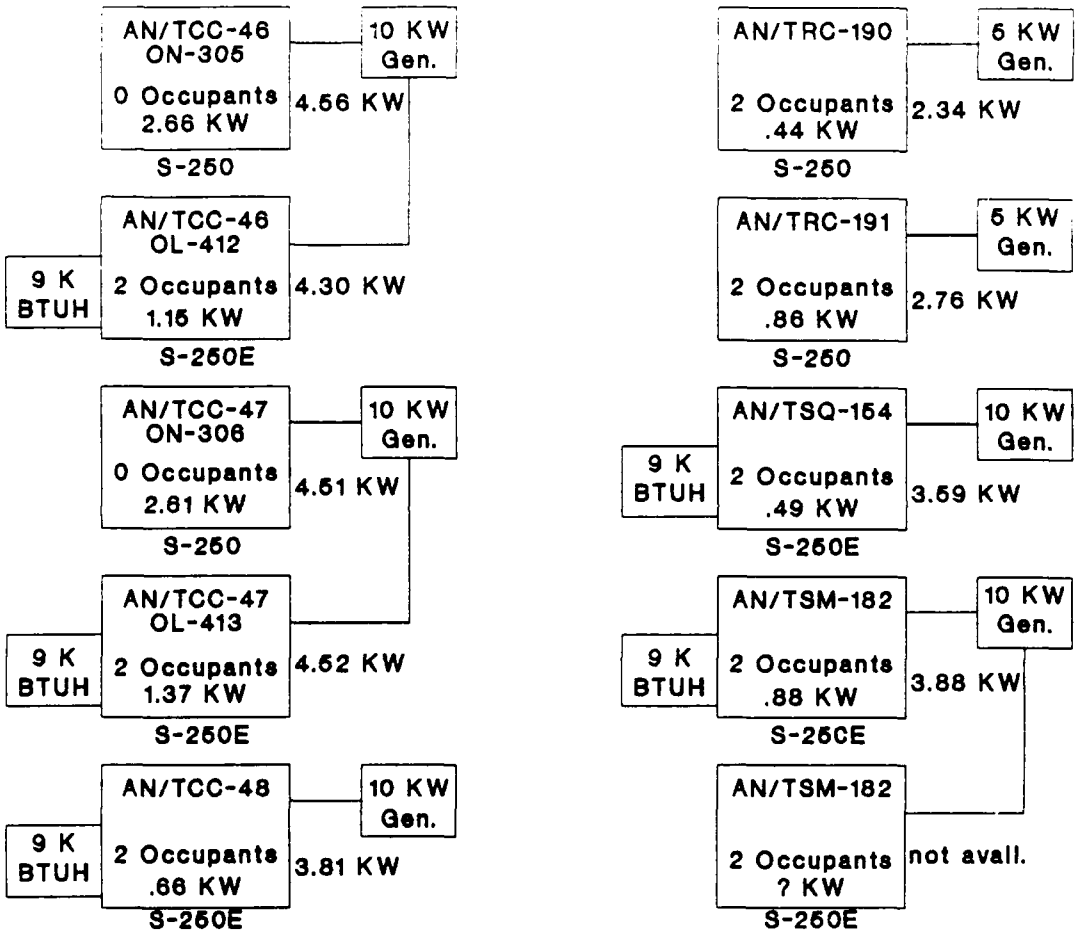

Figure 4. System Overview

Appendix

COBRO
AN EMPLOYEE OWNED COMPANY

SR90-161

November 8,1990

Special Report

Air Conditioner Requirements Review
Power Using Equipment Inventory
Mobile Subscriber Equipment

PREPARED FOR:

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SPECIAL REPORT
AIR CONDITIONER REQUIREMENTS REVIEW

MOBILE SUBSCRIBER EQUIPMENT ASSESSMENT

INTRODUCTION

This special report on field data collected has been prepared to provide Belvoir Research, Development and Engineering (RD & E) Center's Systems Assessment Team selected information about Mobile Subscriber Equipment (MSE), an Army system designated by U.S. Army Ordnance Center and School (Letter, ATSL-CD-MS, Subject: Air Conditioner Requirements Review, dated 19 September 1990) as a system best suited to provide input to an air conditioner requirements analysis.

PROGRAM OVERVIEW

The collected information from each of nine systems will be summarized by the Systems Assessment Team in a concise, meaningful form, and conveyed to the Training and Doctrine Command (TRADOC) Air Conditioner Requirements Review (ACRR) Team at the U. S. Army Ordnance Center and School for consideration as the team addresses and recommends attributes for a new standard family of tactical air conditioners.

The specified systems are:

TACFIRE	-Direction Center, Artillery
FAADS	-Forward Area Air Defense System
JTIDS	-Joint Tactical Information Distribution System
SICPS	-Standardized Integrated Command Post System
MSE	-Mobile Subscriber System
PATRIOT	-Air Defense Missile System
DAS3	-Decentralized Automated Service Support System
HAWK	-Air Defense Missile System
TACMIS	-CTASC-II, Corps/Theater ADP Service Center

Coordination to gain access to the target systems is done at command levels. Local schedules and task interpretation at the owning unit is done by COBRO representatives on site.

DATA COLLECTION INFRASTRUCTURE

The data collection phase of the ACRR program utilizes Belvoir's Tactical Assessment of Power (TAP) Sample Data Collection (SDC) Program. The TAP program was selected to support the ACRR program because all of the field data can be obtained in similar fashion without adding additional people.

TAP is supported in the field using the contracted support infrastructure for SDC. COBRO Corporation provides the support to TAP and to ACRR through its offices at Fort Belvoir, Fort Bragg, Fort Hood, and others, depending upon where the target systems can be located.

DATA OBJECTIVES

The collection is focussed on the equipment listed under Program Overview. The purpose is to develop detailed data on tactical power consumers, tactical shelters, tactical air conditioners mounted on the tactical shelters, shelterized system crew staffing, system environmental capability, system operating profiles, and crew training and experience.

COLLECTION METHODOLOGY

Data are collected on site by a team of people organized to perform a subsystem inventory; conduct a controlled, power-up procedure; measure operating and environmental parameters; and debrief operators about their training on the system, their field experience with the system, and the system's operating modes.

The field team consists of a Senior Technician and an Engineer from the Systems Assessment Team at Fort Belvoir. A Field Monitor from a COBRO Corporation field office and the COBRO Senior Technical Analyst for the TAP SDC Program at Fort Belvoir completes the team.

At the field site the team accomplishes the following:

Assistance of the system operator(s) is solicited to identify the separate power consuming subsystems/components of the system housed in the shelter. The inventory data are posted to the Power Using Inventory form (Figure 1).

The interrelationships and power supply lash-up is reviewed as a basis for developing the measurement test plan. Initially the plan is tentative and can be sensitive to the unexpected. The plan is modified as necessary and posted to the Power Measurement Load Configuration form (Figure 2) as a sequence of power-up events. Measured results of the power-up sequences are posted by input power phase (A,B, and C) to the Power Generator Performance Data form (Figure 3).

Notes about shelter size, trailer information, prime movers, generators, and air conditioners are taken. Operators and crew members are debriefed to gain insight to operating modes, if they exist; operating conditions; training; and field experiences. Debriefings are based on the format presented in Figure 4.

The team reviews the information gathered and conducts a verification analysis to insure values of voltage, current, and wattage can be determined for each component on the inventory; either measured directly or calculated from other measured values.

POWER ANALYSIS

Values recorded on the Power Generator Performance Data Form are verified by the Systems Assessment Team at Fort Belvoir using procedures calculated to establish the power values to be used later in Fort Belvoir's Shelter Systems Assessment Model (SAM).

SAM is exercised to determine cooling requirements that maintain Human Engineering habitability conditions (MIL-STD-1472) at various climate conditions.

MSE DESCRIPTION

MSE is a full-featured, all-digital telecommunications system for the tactical battlefield. It provides both mobile and static users in corps and division areas with automatic switch, survivable, secure voice, data and facsimile communications. The system provides equipment for five functional areas, and maintenance support.

Subscriber Terminals	DNVT Telephones (TA-1035/U) Facsimile (AN/UXC-7) Data Interface
Mobile Subscriber Access	MSRT (AN/VRC-97)
Wire Subscriber Access	LES (AN/TCC-46) SES (AN/TTC-48(V)) LOS (AN/TRC-190(V))
Area Coverage	NCS (AN/TCC-47) RAU (AN/TRC-191) LOS (AN/TRC-190(V))
System Control	SCC Technical Control and Planning Center AN/TYQ-35(V)

MSE POWER CONSUMING EQUIPMENT INVENTORY

The MSE inventoried and assessed is assigned to C Company, 16th Signal Battalion, 3rd Signal Brigade at Fort Hood, Texas. Nine shelterized components of the MSE provided the data.

Model	Nomenclature
AN/TTC-46	Switching Group (ON-305) Operations Group (OL-412)
AN/TTC-47	Switching Group (ON-306) Operations Group (OL-413)
AN/TTC-48	Small Extension Node
AN/TRC-190(V)	Line-of-sight Radio Terminal
AN/TRC-191	Radio Access Unit
AN/TSQ-154	Management Facility
AN/TSM-182	Maintenance Facility

Large Extension Node Switch, AN/TTC-46. AN/TTC-46 consists of a switching group and an operations group, each in its own S-250 shelter. The operations shelter is an S-250E (Extended). Three people make up the crew. The system is powered by a PU-753/M, 10KW, diesel generator set which is towed by a 1 1/4-ton, M1037 truck. The operations shelter is environmentally controlled by a 9,000 BTU unit and a blower. The switching shelter has two blowers and a separate heater.

POWER CONSUMING EQUIPMENT

Switching Group, AN/TTC-46, OL-305

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture, Light Fluorescent	1 bulb	None available
AA008	None	Light	Incand	None available
AG013	None	Heater	P-15	None available
AG072	K23214	Tsec	KGX-93	5810-01-212-8128
AG071	T08971	Tsec	KG-94A	5810-01-213-8200
AD100	None	Blower	None	None available
AO016	None	Supply, Power	PP-7815	5805-01-120-2929
AO015	None	Supply, Power	PP-7711	5805-01-120-2982
BG	K94880	Set,Intercom	LS-147C/FI	5830-00-752-5357
AM063	None	Oscillator, Frequency	0-1838	5999-01-218-3901
AM064	None	Group,Time Division Sw	None	03-2733009-1
AM065	None	Group,Time Division Sw	None	03-2733008-1
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724

Operations Group, AN/TTC-46, OL-412

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture,Light Fluorescent	1 bulb	None available
AA008	None	Light	Incand	None available
AM028	None	Transport, Tape	AN/UYH-5	7025-01-125-5767
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
AE060	T45408	Telephone, Digital	TA-1035/U	5805-01-246-6826
AX034	V36146	Terminal, Communications	AN/UGC-74	5815-01-214-6237
AM029	None	Keyboard	IR-154/G	7025-01-252-5443
AM055	None	Unit,Orderwire Control	C-11878/T	5805-01-254-0333
BG	K94880	Set,Intercom	LS-147C/FI	5830-00-752-5357
AM053	None	Panel, Control Alarm	None	09-2733614
AM054	None	Panel, Call Service Posn	SMD817230	5805-01-242-6498
AK034	A23828	Conditioner,Air	H9KH-115P	4120-01-136-2214
AD100	None	Blower	None	None available
AM050	None	Receiver Transmitter	AN/GRC-224	5820-01-247-9116
AM051	None	Group,Central Processor	OL-386	SM-E-819488-2
AM052	None	Bay,Routing	None	30841740-D
BE020	None	Converter	CV3734T	5805-01-130-1499
		Display, Video	SMD820662	None available

Node Center switch, AN/TTC-47. AN/TTC-47 consists of a switching group and an operations group, each in its own S-250 shelter. The operations shelter is an s-250E (Extended). Three people make up the crew. The system is powered by a PU-753/M, 10KW, diesel generator set which is towed by a 1-1/4-ton, M1037 truck. The operations shelter is environmentally controlled by a 9,000 BTU unit and a blower. The switching shelter has two blowers and a separate heater.

POWER CONSUMING EQUIPMENT

Switching Group, AN/TTC-47, ON-306

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture,Light, Fluorescent	1 bulb	None available
AA008	None	Light	Incan	None available
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
BG	K94880	Set, Intercom	LS147C/FI	5830-00-752-5357
AG071	T08971	Tsec	KG-94A	5810-01-213-8200
AO016	None	Supply, Power	PP-7815	5805-01-120-2929
AO015	None	Supply, Power	PP-7711	5805-01-120-2982
AG013	None	Heater	P-15	4520-00-912-3502
AM063	None	Oscillator	0-1838	5999-01-218-3901
AD100	None	Blower	None	None available
	None	Tsec	KGX-93	None available

Operations Group, AN/TTC-47, OL-413

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture,Light, Fluorescent	1 Bulb	None available
AA008	None	Light	Incan	None available
AK034	A23828	Conditioner, Air	H9KH-115P	4120-01-136-2214
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
AM028	None	Transport, Tape	AN/UYH-5	7025-01-125-5767
AE060	T45408	Telephone, Digital	TA-1035/U	5805-01-246-6826
AM050	None	Receiver Transmitter	AN-GRC-224	5820-01-247-9116
AM051	None	Group, Central Processor	OL-386	SM-E-819488-2
BE020	None	Converter	CV-3734T	5805-01-130-1499
AM052	None	Bay, Routing	None	30841740-D
AM053	None	Panel, Control Alarm	None	09-2733614
AM054	None	Panel, Call Service Posn	SMD817230	5805-01-242-6498
AM055	None	Unit, Order Wire Control	C-11878/T	5805-01-254-0333
AM029	None	Keyboard	IR-154/G	7025-01-252-5443
AX034	V36146	Terminal, Communications	AN/UGC-74	5815-01-214-6237
AG070	S01373	Tsec	KY-57	5810-00-434-3644
AD100	None	Blower	None	None available
BG	K94880	Set, Intercom	LS-147C/FI	5830-00-751-5357
	None	Display, Video	SMD820662	None available

Small Extension Node, AN/TTC-48. AN/TTC-48 consists of two Switchboards, SB-4303(P)/G, in an S-250 shelter. Three people make up the crew. The system is powered by a PU-753/M, 10KW, diesel generator set which is towed by a 1 1/4-ton, M1037 truck. The shelter is environmentally controlled by a 9,000 BTU unit and a blower unit.

POWER CONSUMING EQUIPMENT

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture, Light Fluorescent	1 Bulb	None available
AA008	None	Light	Incan	None available
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
AE060	T45408	Telephone, Digital	TA-1035/U	5805-01-246-6826
AK034	A23828	Conditioner, air	H9KH-115P	4120-01-136-2214
AM058	None	Module, Logic Group	TD-1426PT	None available
AG071	T08971	Tsec	KG-94A	5810-01-213-8200
AB008	None	Supply,Power, Group Modem	MD-1231PT	G369291
AM055	None	Unit, Order Wire Control	C-11878/T	5805-01-254-0333
AG070	S01373	Tsec	KY-57	5810-00-434-3644
AE061	None	Switchboard, Telephone	SB-4303PG	5805-01-253-6148
AD100	None	Blower	None	None available

Line of Sight Radio Terminal, AN/TRC-190(V)4. The AN/TRC-190(V)4 consists of AN/GRC-226(V) and AN/GRC-224 radios and Digital Group Modems in an S-250 shelter. The system is powered by a 5KW, diesel, generator which is towed by the 1 1/4 Ton M-1037 truck. The system is not equipped with an air conditioner but has two blowers mounted on the front of the shelter. A separate heater unit is included. This system is one of four versions of the Line of Sight Radio system.

POWER CONSUMING EQUIPMENT

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture, Light Fluorescent	1 Bulb	None available
AA008	None	Light	Incan	None available
AM056	None	Receiver Transmitter	AN/GRC-226	5820-01-248-4767
AM050	None	Receiver Transmitter	AN/GRC-224	5820-01-247-9116
AG013	None	Heater	P-15	4520-00-912-3502
AM057	None	Receiver Transmitter	AN/GRC-226	5820-01-249-0356
AG070	S01373	Tsec	KY-57	5810-00-434-3644
AM055	None	Unit, Order Wire Control	C-11878/T	5805-01-254-0333
AB008	None	Supply,Power, Group Modem	MD-1231PT	G369291
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
AD100	None	Blower	None	None available

Radio Access Unit, AN/TRC-191. AN/TRC-191 consists of eight RT-1539(P)A(C)/G radios with Digital Group Modems in an S-250 shelter. Three people make up the crew. The system is powered by a PU-751/M, 5KW, diesel, generator set which is towed by a 1 1/4-ton, M1037 truck. The shelter is environmentally controlled by two blowers mounted on the front of the shelter. A separate heater is included.

POWER CONSUMING EQUIPMENT

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture, Light Fluorescent	1 Bulb	None available
AA008	None	Light	Incan	None available
AD100	None	Blower	None	None available
AG013	None	Heater	P-15	4520-00-912-3502
AM055	None	Unit, Control, Order Wire	C-11878/T	5805-01-254-0333
AM058	None	Module, Logic Group	TD-1426PT	None available
AB008	None	Supply,Power, Group Modem	MD-1231PT	G369291
AM059	None	Receiver Transmitter	RT-1539	5820-01-247-9118
AM060	None	Multicoupler, Antenna	CV-2391	5985-01-247-9115
AM061	None	Controller, Recvr Trans	C-11865	5820-01-252-9770
AM062	None	Control, Radio Access Unit	K-022	00727274
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
AE060	T45408	Telephone, Digital	TA-1035/U	5805-01-246-6826
AG070	S01373	Tsec	KY-57	5810-00-434-3644
AG071	T08971	Tsec	KG-94A	5810-01-213-8200

Management Facility, AN/TSQ-154. AN/TSQ-154 has the equipment and space required by the Node Center Platoon Leader and Platoon Sergeant to manage platoon assets. The facility is housed in an S-250 extended shelter. One operator completes the crew of three. The system is powered by a PU-753/M, 10KW, diesel generator set which is towed by a 1 1/4-ton, M1037 truck. The shelter is environmentally controlled by a 9,000 BTU unit.

POWER CONSUMING EQUIPMENT

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture, Light Fluorescent	1 Bulb	Nonme available
AA008	None	Light	Incan	None available
BG	K94880	Set, Intercom	LS-147C/FI	5830-00-752-5357
AE062	L67964	Facsimile	AN/UXC-7	5815-01-187-7844
AD044	None	Computer, Zenith	2FL-171-42	None available
AE063	None	Printer	ASP1000	None available
AK034	A23828	Conditioner, Air	H9KH-115P	4120-01-136-2214
AE060	T45403	Telephone, Digital	TA-1035/U	5805-01-246-6826
AA025	None	Light, Flourescent	Ext Mobile	BR8023-506
AX034	V36146	Terminal, Communications	AN/UGC-74	5815-01-214-6237
AL057	P40750	Supply, Power	PP-6224/U	6130-01-223-0267
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724

Maintenance Facility, AN/TSM-182. AN/TSM-182 consists of two S-250 extended shelters on M-1037 trucks; one vehicle tows a PU-753/M, 10KW, diesel, generator, and the other vehicle tows a cargo trailer. Each shelter provides bench space for two repairmen and storage space. One shelter is environmentally controlled by 9,000 BTU unit.

POWER CONSUMING EQUIPMENT

System Code	Line Number	Nomenclature	Model	Stock Number
AA024	None	Fixture, Light Fluorescent	1 Bulb	None available
AA008	None	Light	Incan	None available
AB007	None	Charger, Battery	PP-8190/G	6130-01-252-9724
AM066	None	Controller	None	None available
AM067	None	Oscilloscope	None	None available
AE060	T45408	Telephone, Digital	TA-1035/U	5805-01-246-6826
AM068	None	Unit, Tape Control	None	None available
AM069	None	Generator, Signal	8642M	None available
AM070	None	Device, Interconnect	009643-01	None available
AM071	None	Counter, Frequency	1992	None available
AM072	None	Meter, Microwatt	4200	None available
AM073	None	Multimeter	8840A/AF	None available
AM074	None	Supply, Power	6255A	None available
AM075	S65581	Generator, Signal	SG-1171/U	6625-01-133-6160
AK034	A23828	Conditioner, Air	H9KH-115P	4120-01-136-2214

DEBRIEFING

Team Chiefs were debriefed on operational modes and areas of interest about the environmental control system. The information provided by the operator in response to questions asked follows:

Demographics

Briefee	Team Chiefs
Military Occupational Specialty	MSE MOS
Training	GTE and Signal School
Time on MSE	Approximately 1 year
Field exposure during MSE assignment	Field training exercises

Modes of Operation

What are the MSE's modes	Operating
Number of operators required	Three per manned shelter
Define operation	System on, operators Monitoring
Longest required duration	As required
Status of shelter door	Closed during operation

NBC

Collective protection for NBC	No

Environmental Control

Shelter has ECU	Yes
ECU description	Hor A/C, 60Hz, 208VAC, 3Ph 10,000 BTU
Model	H9KH-115P
Heating	10,000 BTU
Cooling	7,000 BTU
How often ECU used	Full time

Comfort during hot weather	Reasonable
Comfort during cold weather	Reasonable
Proper operating temperatures	Yes, with the ECU
Proper operating temperatures (Cold)	Adequate
Operation of ECU unit	Easy
Your problems with ECU	Although relatively new, several have required maintenance actions.
Maintenance	Adequate
Other comments pertinent	None

SYSTEMS INVENTORY FORM

1. Control Number	2. Line Number	3. NSN	4. Nomenclature	5. Model	6. Prime Mover/Model	7. System Gen. Code	8. KW	9. Type Shelter	10. Weight
FU00504									

11. Reference Document	12. Manufacturer	13. Frequency (HZ)				14. Voltage							15. Phase				16. Number Operators	17. Source Of Values				18. Date
		DC	50	60	400	20	110	120	208	220	240	416	Single	3PH	DC	Other						

SUB SYSTEM

19. System Code	20. Line Number	21. Nomenclature	22. Model	23. NSN	24. Required			25. Type Voltage		26. System BTU		27. Value Source				28. Qty	29. Remarks
					Volts	Amps	Watts	AC	DC	Heating	Cooling	M	C	S	T		

Figure 1. System Inventory Form

Power Measurements Data Matrix

Power Measurement Load Configuration

Page ___ of ___

System _____

Date __/__/__

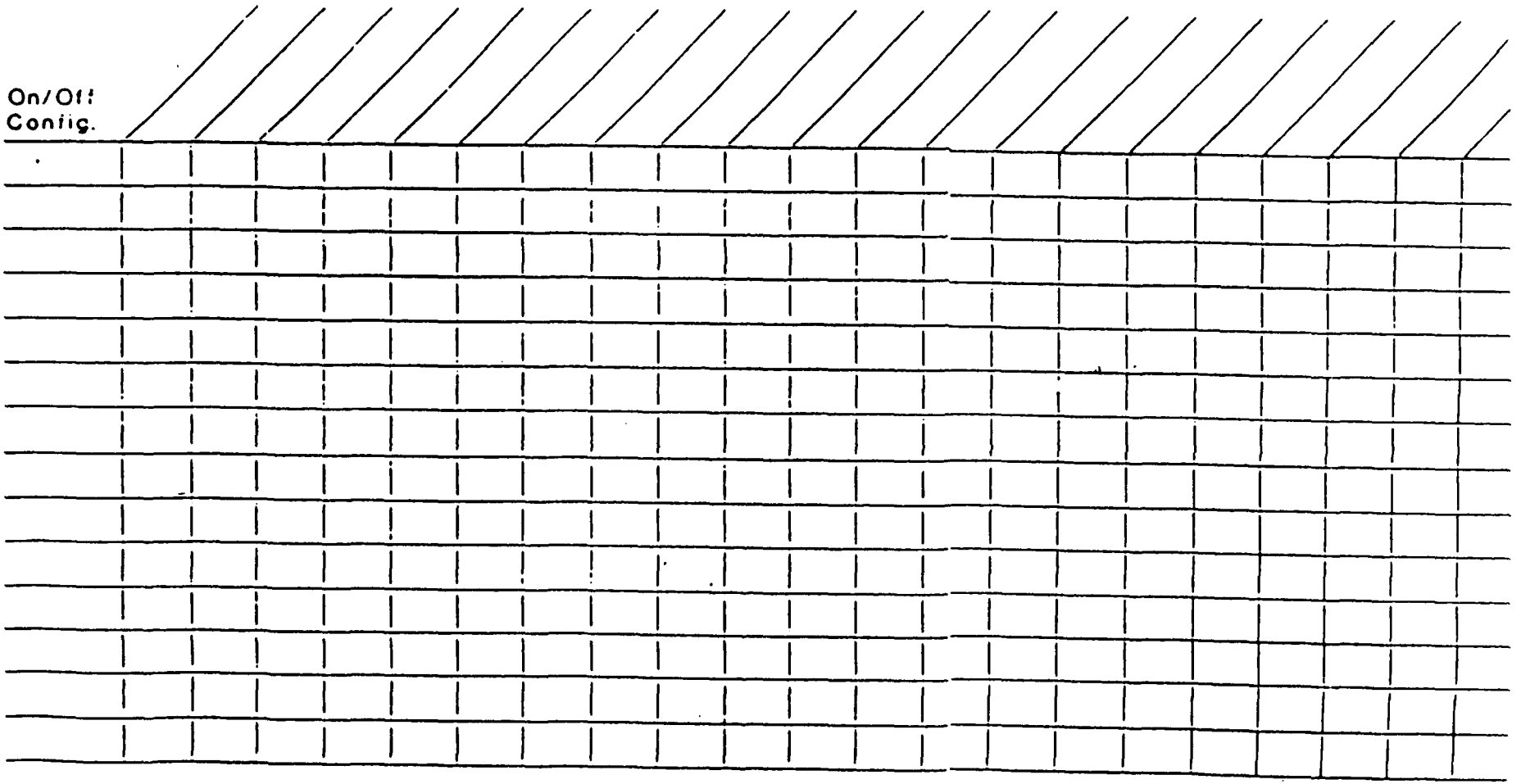

Figure 2. Power Measurement Load Configuration

Power Measurements Data Matrix

Page ___ of ___

Power Generator Performance Data

Date __/__/__

System _____

On/Off Config.	Phase A				Phase B				Phase C			
	V	A	W	PF	V	A	W	PF	V	A	W	PF

Figure 3. Power Generator Performance Data

Air Conditioner Requirements Review

INTRODUCTION

The information in this completed debriefing is supplemental to and becomes part of the unbundled system data file.

The data for this portion of the Air Conditioner Requirements Review will be obtained by a member of the TAP program Unbundling Team during an informal discussion with an assigned operator of the unbundled system. The following sections should be used to guide the discussion.

SYSTEM DESCRIPTION

1. Date: _____

2. System Unbundled: _____

3. Location: _____

4. Site Description: _____

_____

SYSTEM POWER REQUIREMENTS

5. What Type of Power Does the System Require? ____60Hz; ____DC;

____400Hz; Single Phase? ____120v; ____240v; Three Phase?

____208v; ____416v?

6. For DC Systems, What Equipment Requires the DC Power? _____

_____

7. For 400Hz Systems, What Equipment Requires the 400Hz Power? _____

_____

DEMOGRAPHICS

8. Briefer: _____

9. Briefee: _____ MOS: _____

10. Training: ____ School ____ OJT ____ When? _____

11. Length of Assignment to System: Years _____ Months _____

12. Field Exposure While Assigned: _____

Figure 4. Debriefing Format

_____

_____

MODES OF OPERATION

13. What are the System's Mode(s) of Operation?

_____

_____

14. How Many Operators Required For Each Mode?

15. Low _____

16. Moderate _____

17. High _____

18. Your Understanding of Low Intensity Operation. _____

_____

_____

19. Your Understanding of Mid Intensity Operation. _____

_____

_____

20. Your Understanding of High Intensity Operation. _____

_____

_____

21. What Is the Expected Duration for High Intensity Operation? _____

_____

_____

22. What Is the Longest Required Duration for High Intensity Operation

_____

_____

Figure 4. Debriefing Format (Continued)

23. Which of the Three Operational Levels Have You Operated the System? ____ Low ____ Mid ____ High

24. Do You Normally Operate the System With the Shelter Door Open ____ Or Closed ____?

NBC

25. Is the Shelter Equipped with Collective Protection for NBC (CBR) conditions? ____

26. How Well Does the Collective Protection System Work? _____

_____

_____

ENVIRONMENTAL CONTROL UNIT

27. Does the Shelter Have An ECU? ____ Yes ____ No

28. ECU Nomenclature: _____

29. Model: _____

30. Heating: _____ BTU

31. Cooling: _____ BTU

32. How Often Do You Use the ECU? _____

_____

33. What Is Your Assessment Of the Interior Comfort When Your System Is Being Operated For Extended Periods During Hot Weather? _____

_____

34. What Is Your Assessment Of the Comfort When Your System Is Being Operated For Extended Periods During Cold Weather? _____

_____

_____

Figure 4. Debriefing Format (Continued)

35. Do You Think the ECU Adequately Maintains Proper Equipment Operating Temperatures?

36. During Hot Weather? _____

37. During Cold Weather? _____

38. How Would You Categorize Operation (Operator Interface) Of the ECU?

39. Easy ____

40. Difficult ____

41. Complex ____

42. What Problems Have You Experienced With the ECU? _____

43. 1. _____

44. 2. _____

45. 3. _____

46. What Other Comments Regarding the System, Its operation, Air Conditioning, Heating, Or Collective (NBC/CBR) Protection Would You Like To Note? _____

Figure 4. Debriefing Format (Continued)

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